

CLAIMS.

1. A method and composition of surface plasmon resonance enhanced multiband absorption and multiband fluorescence for optochemical sensing and molecular identification comprises:
 - a) A molecule, electromagnetic radiation and a metal nanoparticle interacting on each other causing enhanced multiband absorption and multiband emission of the molecule,
 - b) An analyte chemically or physically interacting with the molecule in the presence of the metal nanoparticle, wherein said the analyte modifies multiband absorption and multiband emission properties of the molecule,
 - c) A spacer to control distance between the molecule and the metal nanoparticle to optimize multiband absorption and multiband emission from the molecule,
 - e) A sensor for optochemical sensing of analytes by surface plasmon resonance enhanced multiband absorption and multiband emission of the molecule,
 - f) An electromagnetic radiation source or chemical source for excitation the molecule and the metal nanoparticle.
2. The method of claim 1, wherein the molecule comprises an organic molecule, inorganic molecule, biomolecule.
3. The method of claim 2, wherein the molecule is fluorophore and is selected from the group consisting of a protein, amino acid, oligonucleotide, lipid, sugar moiety, purine or pyrimidine, nucleoside or nucleotide, genetically engineered

biomolecule, fluorescence dye, fluorescence biomarker, metal ligand charge transfer complex, up-converted fluorophore, fluorescence dendrimer, pair of fluorescent donor and fluorescent acceptor, pair of fluorescent donor and quencher, fluorescent metal nanoparticle.

4. The method of claim 1, wherein the analyte is selected from the group consisting of glucose, inorganic molecule, protein, amino acid, oligonucleotide, lipid, sugar moiety, purine or pyrimidine, nucleoside or nucleotide.
5. The method of claim 1, wherein the spacer is selected from the group consisting of a biorecognitive spacer, dielectric spacer, chemical link spacer, analyte sensitive spacer, polymer.
6. The method of claim 1, wherein the metal nanoparticle is a metal, conducting material, super conducting material, semi conducting material.
7. The method of claim 6, wherein the metal is selected from the group consisting of silver, ruthenium, platinum, rhenium, rhodium, osmium, iridium, copper, palladium and gold.
8. The method of claim 1, wherein the metal nanoparticle is sub-wavelength in size.
9. The method of claim 1, wherein the spacer separates the molecule from the metal nanoparticle by distance longer than 10 nm.
10. The method of claims 1, wherein the sensor comprises of the single metal nanoparticles and electro-magnetic radiation interacting with molecules at the specific location.
11. The method of claim 1, wherein the sensor comprises at least one thin film of nanoparticles coated on an optical material of refractive index values from 1 to

- 3.5 and electro-magnetic radiation interacting with the molecules and metal nanoparticles.
12. A method of claims 1, for optochemical sensing of the multiband absorption and multiband fluorescence of the molecule, said method comprising the steps of: (a) positioning the nanoparticle and the molecule at a distance apart sufficient to manipulate the multiband fluorescence from the molecule; (b) exposing the molecule to exciting radiation in the single-photon and multi-photons modes of excitation; and (c) analyzing the multiband absorption and multiband fluorescence from the molecule.
13. The method of claims 1, wherein the sensor is a microarray, bio-chip, flow cell, endoscope, microscopic slide, total internal reflection cell, catheter, optical fiber, waveguide.
14. The method of claim 1, wherein the electromagnetic radiation source is selected from the group consisting of a laser with single wavelength, laser with plurality wavelengths, laser diode, light emitted diode, lamp, bioluminescence, chemiluminescence, electroluminescence.
15. The method of claim 1, and 12, wherein the method of optochemical sensing comprises analyses of a low excited state and higher excited states absorption and fluorescence bands of the molecule.
16. The method of claim 1, and 12, wherein the method of molecular identification comprises analyses of the low excited state and higher excited states absorption and fluorescence bands of the molecule.

17. The method of claim 15, and 16, wherein the low excited state and higher excited states absorption and fluorescence bands of the molecule comprises analyses of absorption spectra, fluorescence intensity, fluorescence polarization, fluorescence spectra, hyperspectral imaging, fluorescence lifetime, enhanced Raman scattering, one-photon and multi-photon microscopy, one-photon and multi-photon spectroscopy, fluorescence recovery after photobleaching, fluorescence immunoassay, fluorescence resonance energy transfer.
18. A method of claim 1 for engineering multiband fluorescence lifetime of the molecule by changing the distances of the molecule adjacent to the nanoparticle; and exposing the molecule to an amount of exciting radiation in the single-photon and multi-photons modes of excitation.
19. A method of claim 1 for increasing multiband fluorescence resonance energy transfer on a labeled molecule by changing the distances of the molecule adjacent to a metal particle; and exposing the molecule to an amount of exciting radiation in the single-photon and multi-photons modes of excitation.
20. A method of claim 1 and 12 for optical sensing with multiband emission and multiband absorption of the molecule wherein the analyte sensitive spacer modifies multiband emission and multiband absorption of the molecule.